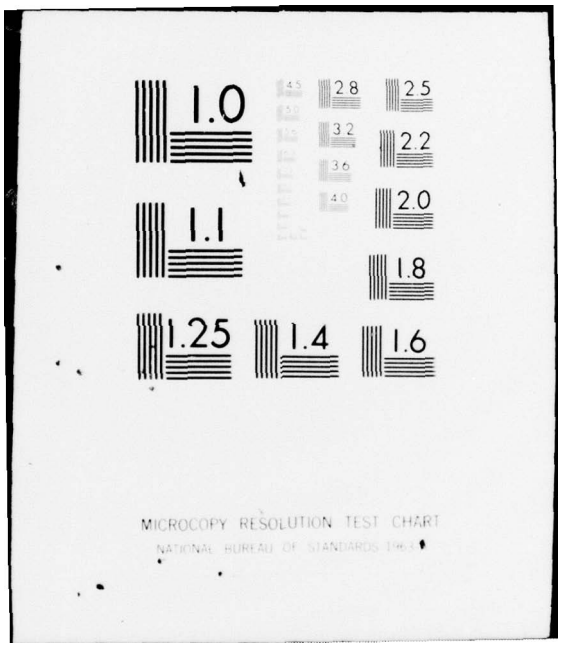
AD-A045 189 ARMY MEDICAL INTELLIGENCE AND INFORMATION AGENCY WAS--ETC F/G 6/21
EXPERIENCE WITH THE TREATMENT OF BLOOD VESSEL WOUNDS IN FORWARD--ETC(U)
SEP 77 V L KHENKIN

UNCLASSIFIED USAMIIA-K-8350 NL

1 OF 1
AD
A045189

END
DATE FILMED
11-77
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

DEPARTMENT OF THE ARMY
U.S. ARMY MEDICAL INTELLIGENCE AND INFORMATION AGENCY
WASHINGTON, D.C. 20314

(1)

USAMIIA TRANSLATION

(14) Number: USAMIIA-K-8350

(11) Date Completed: 14 Sep 1977

(12) 10 p.

Language: Russian

Geographic Area:

(6) English Title: EXPERIENCE WITH THE TREATMENT OF BLOOD VESSEL WOUNDS IN FORWARD AND ARMY AREAS

Foreign Title: (Opyt lecheniya raneniy krovenosnykh sosudov v voyskovom i armeyskom rayone)

(10) Author: V. L. Khenkin

(21) Trans. 10

Source Document: Khirurgiya, Vol V 14 (USSR)

Pages Translated: pp 50-57 1944.

Publisher:

Date/Place Publication: 1944, Moscow

Distribution Statement: Approved for public release; distribution unlimited

409112

EXPERIENCE WITH THE TREATMENT OF BLOOD VESSEL WOUNDS IN FORWARD AND ARMY AREAS

Moscow KHIRURGIYA in Russian Vol 14, 1944 pp 50-57

[Article by Medical Major V. L. Khenkin, candidate of medicine]

In previous wars, especially the first imperialist war, the number of blood vessel wounds constituted 5.5 to 5 percent of all wounds (Bogoraz, Braytsev, and others). Due to the mass of automatic weapons, mines, and hand grenades now available to the belligerent armies and the capacity of these weapons to produce vast quantities of fragments with great penetrating power, cases of vascular wounds are common. Although many wounded soldiers remain on the battlefield, large numbers of those removed from the battlefield and given srugical treatment are found to have injured blood vessels. The diagnosis of these wounds still leaves much to be desired. According to the records of front and army pathologic anatomy laboratories, almost 9 percent of all autopsies revealed vascular wounds that were not diagnosed during life. We still do not know the exact frequency of these wounds, but preliminary observations suggest they constitute 3 percent of the total. During World War II we recorded 512 cases of vascular wounds in 203 of which we operated personally. Data on these 512 cases are given in Table 1.

Table 1

Blood Vessel	Number of Cases	Operations Performed	
		In a Forward Area	In an Army Area
Common carotid artery	23	10	13
External carotid artery	6	2	4
Aortic arch	1	--	1
Subclavian artery	15	2	13
Axillary artery	18	4	14
Humeral artery	56	29	27
Radial artery	63	51	12
Ulnar artery	20	13	7

Blood Vessel	Number of Cases	Operations Performed: In a Forward Area	Operations Performed: In an Army Area
Palmar arch artery	26	14	12
External iliac artery	12	4	8
Internal iliac artery	10	5	5
Femoral artery	65	36	29
Inferior gluteal artery	4	--	4
Popliteal artery	44	14	30
Anterior tibial artery	81	26	55
Peroneal artery	69	31	38
Total	513	241	272

The diagnosis of blood vessel wounds is not always easy and, as a result, serious errors are sometimes made, for example, unexpectedly heavy bleeding during primary surgical treatment, erroneous opening of a pulsating hematoma or false aneurysm mistaken for a common abscess. Finally, late diagnosis often results in severe heavy secondary bleeding both in a medical installation and at an evacuation station.

With any wound in the region of large blood vessels, the surgeon must be aware of the possibility that they, too, might be injured. Examination of a wounded extremity should start with measurement of the peripheral pulse and the absence or weakening of it compared to that in the healthy extremity should arouse the suspicion of injury to the nearby vessels. The surgeon's attention should similarly be drawn to possible extensive subcutaneous hemorrhages, even though they are not always present. Diffuse swelling in the region of a wound that is visible to the naked eye or palpatable pulsation of this swelling as well as sounds heard over it (such swellings should always be auscultated) invariably confirm the diagnosis of vascular wound. All these signs need not be very pronounced and some of them may in fact be absent, but attentive, methodical inspection of the wound, palpation and auscultation of the tissues surrounding it, and measurement of the peripheral pulse may prevent diagnostic errors. If a large blood vessel is injured and the wound not diagnosed within a few hours or if it is diagnosed and no operation performed, a pulsating hematoma will form and be followed by a false aneurysm.

Besides these main symptoms, there are signs of circulatory disturbances in the distal portions of the extremity in the form of change in skin color (pallor or cyanosis), edema and sometimes gangrene, generally the dry form. Gangrene occurs fairly often in arteriovenous injuries. Pain in the distal portion of an extremity is usually associated with false arterial aneurysms. We did not observe any cardiac changes in pulsating arteriovenous hematomas, which occurred in 68 percent of all arteriovenous aneurysms. These changes were manifested by dyspnea, tachycardia, and pain in the heart. The heart margins were enlarged to the right in 31 percent of the cases and sounds

were sometimes heard over the aorta and pulmonary artery. Bradycardia was observed in 92 percent of false arteriovenous aneurysms and in 1.5 percent of pulsating arteriovenous hematomas.

As soon as a blood vessel wound is diagnosed, the attention not only of the surgeon but of all attending personnel should be drawn to the victim. If there is no external bleeding and the operation is postponed for one reason or another, we apply a tourniquet to the extremity after carefully immobilizing it and tighten the tourniquet at the first signs of bleeding. Although the patient's condition determines the time the operation is performed, we believe a vascular wound should be operated on in the stage of evacuation at which it is diagnosed. With information on the injury to a large blood vessel available, primary surgical treatment of the wound should start in the operating room of the medical battalion. The surgeon should apply a temporary sterile tourniquet and be ready to ligate the vessel or suture it. In ligating a major artery, we believe the corresponding vein should also be ligated to help prevent gangrene in the distal portion of the extremity. In wounds of large blood vessels, we use vascular suture. The latter is more important in forward and army areas than in the interior when we are dealing with an already formed false aneurysm and have the time to promote the development of collaterals.

Sapozhkov in his article "A New Surgical Treatment of Traumatic Aneurysms" writes: "We refuse to sew up an artery in pulsating hematomas in view of the danger, if infection is present, that the sutures will soon cut through, precipitating severe bleeding and inevitably sharply constricting the lumen of the blood vessel. We also refuse to apply a ligature to a blood vessel above or below the site of injury."* We do not agree with this extremely categorical judgment of Sapozhkov's. Of 107 cases of wounds of large blood vessels that we operated on using vascular suture, pulsating hematomas were present in 67. We also transplanted veins to arterial defects associated with pulsating hematomas. Inspecting the wounded 2 to 4 weeks after the operation, we failed to observe any cutting through of the sutures in even one case. Blood vessels are highly resistant to infection and if a gunshot wound is properly treated, the sutures correctly applied, very strict asepsis maintained during the operation, and the wound dusted with a streptococcicide, there is no reason to fear that the sutures will cut through and cause bleeding and constriction of the lumen of the blood vessel. Ligation of the proximal and distal ends of the vessel, in our opinion, is essential. Our personal findings confirm this (Tables 2 and 3).

Thus, three amputations were performed in 107 cases in which vascular suture was used and 12 amputations in 96 cases involving ligation of the vessels.

It is evident from Table 3 that most of the deaths were due to anaerobic infection. We do not consider this accidental. All the soldiers were

---

* KHIRURGIYA, No 5-6, 1943.

operated on from 10 hours to 3 days after they were wounded. Ligation of the vessel, which markedly aggravated blood circulation in the extremity, contributed, in our opinion, to the development of anaerobic infection.

Table 2

Blood Vessel	Reason for the Operation: Pulsating Hematoma	Reason for the Operation: False Aneurysm	Total	Including: Arterio-venous Injury	Including: Arterial Injury
Common carotid artery	9	4	13	8	5
Aortic arch	1	--	1	--	1
Subclavian artery	6	5	11	5	6
Submaxillary artery	6	--	6	2	4
Humeral artery	4	17	21	11	10
External iliac artery	12	--	12	5	7
Femoral artery	15	17	32	20	12
Popliteal artery	9	2	11	7	4
Total	62	45	107	58	49

Blood Vessel	Outcome: Recovery	Outcome: Death	Outcome: Amputation
Common carotid artery	13	--	--
Aortic arch	--	1	--
Subclavian artery	6	5	--
Submaxillary artery	6	--	--
Humeral artery	21	--	--
External iliac artery	12	--	1
Femoral artery	30	2 (gas)	1
Popliteal artery	11	--	1
Total	99	8	3

Note: The amputations listed in the outcomes are included in the recovery column.

We operated on a soldier for a pulsating hematoma of the femoral artery 3 days after he was wounded. No signs of anaerobic infection were detected at operation. The fragment was removed and the wound was opened wide. Owing to the extensive injury to the artery and poor general condition of the patient as a result of preoperative bleeding, we had to restrict ourselves to ligating the femoral artery and vein. The wound remained open. Gas gangrene set in 8 hours later.

Of 12 amputations, the reason for the procedure was the rapid development of gas gangrene. This was confirmed by the experience of other surgeons of our army who only ligated the vessels.

Table 3. Blood Vessel Wounds Operated on With Ligation in Forward and Army Areas

Blood Vessel	Reason for the Operation: Bleeding	Pulsating Hematoma	False Aneurysm	Total
External carotid artery	1	3	--	4
Humeral artery	2	6	8	16
Radial artery	14	--	--	14
Palmar arch	10	--	--	10
Internal iliac artery	8	--	--	8
Femoral artery	--	1	--	1
Popliteal artery	--	8	1	9
Anterior tibial artery	13	2	1	16
Peroneal artery	12	2	--	14
Inferior gluteal artery (internal iliac artery ligated)	2	2	--	4
Total	62	24	10	96

Blood Vessel	Outcome: Recovery	Death	Amputation
External carotid artery	2	2	--
Humeral artery	12	4 (gas)	1
Radial artery	14	--	--
Palmar arch	10	--	2
Internal iliac artery	7	1	--
Femoral artery	--	1 (gas)	--
Popliteal artery	7	2 (gas)	4
Anterior bibial artery	15	1 (gas)	3 (gas)
Peroneal artery	14	--	2 (gas)
Inferior gluteal artery (internal iliac artery ligated)	4	--	--
Total	85	11 (8 gas)	12 (5 gas)

Note: The abbreviation "gas" refers to the complication of anaerobic infection that developed in operations for bleeding and pulsating hematoma.

As mentioned above, we performed 310 operations. There were 24 deaths and gas gangrene in 7. The limb was amputated in 35 of 286 of those who recovered (11 amputations were due to gas gangrene).

In ligating blood vessels in a forward or army area, it is necessary not only to immobilize the extremity carefully but also inject intravenously 20,000 to 25,000 prophylactic units of antigangrene serum. The patient

must be closely observed for the next 3 to 5 days in order not to miss the possible development of anaerobic infection. If he has to be evacuated, an appropriate notation to this effect should be made on the forward region card or in the individual's medical history.

If there is still a question as to when to operate on a blood vessel in a rear area where the time is determined by the development of collaterals, the operation should be performed in a forward or army region when the wound is diagnosed and the patient's condition permits. In rare cases when the combat situation permitted and when there was a formed pulsating hematoma and no danger of bleeding, we postponed the operation in an army area for 2 or 3 weeks.

Vascular suture is little discussed in recently published articles on blood vessel wounds. The authors present only their own occasional observations. We see no need to defend the technique. Whereas vessels are usually ligated in forward and army areas because young surgeons are not familiar with the suture technique, the latter should be used much more often in the interior than they are at present. In choosing the method, the surgeon should be guided in general by the patient's condition and his own skills. That method is good if the particular surgeon has mastered it. However, when certain blood vessels are injured, e.g., the common carotid and popliteal arteries, vascular suture, in our opinion, is the operation of choice. Of 13 wounded soldiers to whose common carotid artery we applied sutures not one died, whereas of 10 soldiers operated on by other surgeons who used the ligation method on the same artery, 9 died. In 11 cases of sutures that we applied to the popliteal artery, gangrene of the leg set in once, whereas of 32 cases in which this vessel was ligated (24 by other surgeons and 8 by us), the leg had to be amputated in 19. The observation period in our cases was at least 3 weeks or sufficient time to make an accurate evaluation of the results. Vascular suture justified itself even in the presence of an infected wound. In such cases we dusted the wound with a streptococcicide after placing the sutures and then inserted rubber drains which we removed 3 or 4 days later. Immobilization was used after all operations on blood vessels.

While we consider vascular suture the operation of choice in wounds of the common carotid and popliteal arteries, we did not use it in fresh wounds of the popliteal artery. In such cases the operation was very arduous and long. The approach to the proximal and distal portions of the vessel had to be wide and it required subperiosteal resection of the clavicle. When operating in blood-saturated tissues in the midst of a mass of blood clots, despite maximum care, it is difficult to avoid traumatizing the brachial plexus to some extent. A long and traumatic operation on patients suffering from the loss of blood often causes severe operative shock from which they may die. We lost five or six patients and this led us to avoid applying vascular sutures to fresh wounds of the popliteal artery.

Suturing a gunshot wound of the aortic arch seems to be very uncommon, for we failed to find a description of the operation in the available literature.

Our case is as follows.

Patient S., 18 years old, an instructor on sanitary and medical matters, was admitted to a mobile field hospital on 25 December 1941 with a bullet wound on the anterior surface of the neck suffered on 12 December 1941. He lost consciousness after the wound. He received first aid (ligation) in the medical battalion from which he was evacuated to a frontline mobile field hospital and then to a second line hospital. Complaints of labored respiration. Examination of the patient in a semirecumbent position on 31 December. Respiration rapid with a whistling sound; face, vermilion border, lips, and nails cyanotic; pulse 96 beats a minute, rhythmic, soft. Along the posterior margin of the right sternocleidomastoid muscle 2 cm above the clavicle was a bullet hole 1 x 1 cm in size. The wound was filled with flaccid granulations and a slight purulent discharge. On the anterolateral surface of the neck (more to the right) was a large pulsating swelling whose upper border reached the hyoid; the lower border was concealed in the jugular notch, while the lateral and median borders were, respectively, along the posterior and anterior margins of the left sternocleidomastoid muscle. A pronounced systolic murmur was heard over the swelling.

The patient's condition deteriorated markedly during the examination and asphyxia intensified. It was impossible to perform a tracheotomy because the incision would have had to pass through the pulsating hematoma. We performed an emergency operation the same day. An incision was made under local anesthesia over the right clavicle. The clavicle was resected subperiosteally and the subclavian artery and vein were exposed. By gradual dissection along the subclavian vessels we were able to reach the initial portion of the common carotid artery and then continue along it as far as the bifurcation, but we could not find the wound anywhere. We made an incision along the midline of the neck over the swelling in order to perform a tracheotomy. After the platysma was incised, numerous blood clots escaped, respiration was restored, and blood spurted out in a large stream from behind the sternum. With a finger inserted behind the sternum, we felt an opening about 0.5 x 0.5 cm in size and strong pulsation. The bleeding ceased. Without taking out our finger, we removed the manubrium in pieces and then discovered the wound was in the aortic arch. We applied four sutures to the aortic wound above the finger, gradually tightening them as we withdrew the finger. We applied two more sutures. There was no bleeding. Blood was transfused at the same time. Respiratory arrest occurred while the surgical wound was being sewn up, but it was restored in 5 to 8 minutes by artificial respiration. The pulse deteriorated sharply. 800 cm^3 of O(1) blood were transfused. The pulse improved and then began to slow. Blood transfusion was continued but the pulse could not be felt and the patient died 30 minutes after the operation.

Regarding the technique of vascular suture for blood vessel wounds, we wish to emphasize the importance that we attach to preparation of the suture material. The latter should not have any traces of alcohol or mercury chloride. After ordinary treatment with ether, No 0 or No 1 silk is sterilized in an autoclave and then kept in sterile mineral oil.

The approach to the site of injury to the blood vessel should be made from some distance away. We first expose the vessel proximally and then distally to the site. We carefully dissect it off and apply temporary gauze strips to the isolated ends, after which we dissect the vessel in the direction of the injury, gradually moving the gauze strips forward. In doing so we make every effort to spare the collaterals branching off the vessel. As we approach the wound, we tighten the gauze strips and in this way expose the injury site almost bloodlessly.

In the case of fresh wounds of the extremities, we use a tourniquet and immediately expose the injury site, thereby greatly shortening the operation. If an artery and vein are wounded at the same time, especially if an arteriovenous aneurysm or arteriovenous fistula has formed, it is necessary to go around all sides of the arteriovenous anastomosis formed and carefully separate the vessels. Once it is certain that they have been completely severed, a suture or ligature can be applied to each blood vessel separately.

In small parietal wounds, we apply a parietal suture transversely. If the defect in the vessel is larger than its semicircumference, we resect the injured part and suture the vessel end to end. The middle and inner coats are often somewhat contracted, resulting in an excess of adventitia which extends beyond the thread or coils up in the lumen of the vessel. This makes the work much more difficult and impairs the quality of the suture. Hence, we also tighten the adventitia slightly with an ophthalmic forceps and cut away the excess with scissors. We then proceed to sew together the vessel, applying sutures by the Carrel or Jensen-Carrel method. To prevent the ends of the vessel from drying out at this time, they should be moistened with physiologic saline or 4-percent sodium citrate. After the suturing is completed, first the distal end and then the proximal end of the vessel is freed. The slight bleeding from the series of sutures is arrested by compressing the bleeding site with a gauze ball. Heavy bleeding requires additional sutures, which should be placed after compression above and below the injury.

We have been applying of late only a few sutures and surrounding them with a cuff fashioned from the nearest vein. When the defect in an artery is extensive and its ends cannot be brought together, we transplant a piece of the vein to the defect. Ordinarily we use the corresponding vein for this purpose. A venous transplant in extensive injuries to the common carotid and popliteal arteries is, in our opinion, the operation of choice.

Studies run in Bogoraz's clinic (Kartashov, Khenkin) showed that a transplanted vein can withstand arterial pressure and that significant changes take place in its wall over time. The wall thickens, the muscular layer becomes stronger, and the wall of the vein comes to resemble that of the artery. The operation itself is not much more difficult than ordinary suturing of the ends of the vessel. The only difference is that two circular stitches (rather than one) have to be placed because both the proximal and the distal ends of the vein must be sutured. We sew the proximal end of the transplant to the distal end of the wounded vessel and the distal end to the proximal end in order to avoid the possibility of the venous valves impeding the blood flow. A venous transplant has to be 3 to 4 cm longer than the existing arterial defect because the vein contracts after it is resected. And when it is sutured, care must be taken to prevent the sutures from tightening because the thin venous wall is easily cut through. We transplanted venous grafts 6 to 10 cm long, 5, 7, and 4 times for common carotid, femoral, and popliteal artery wounds, respectively. All 16 transplants ended in the recovery of the patients.

Regarding operations for vascular wounds, it should be borne in mind that if 2 or more weeks have elapsed from the time of injury, attention must be paid to the nerve that often lies in the scars surrounding the blood vessels, for it will eventually cause some neurologic disturbances. We invariably remove it with care from the scars and then cover it with muscle. Observance of the above-described technical requirements in connection with operations for blood vessel wounds enabled us to achieve satisfactory results.